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Communication

First Report on the Ethnopharmacological Uses of Medicinal Plants among Monpa Tribe Living in the Zemithang Region of the Arunachal Pradesh, Eastern Himalayas, India

Tamalika Chakraborty [1,2], Somidh Saha [3,4,*] and Narendra S. Bisht [3,5]

[1] Institute of Ethnobotany, Jiwaji University, Gwalior 474001, India; tamalika.chakraborty@waldbau.uni-freiburg.de
[2] Chair of Vegetation Science, University of Freiburg, Freiburg 79085, Germany
[3] Resource Survey and Management Division, Forest Research Institute, Dehra Dun 248006, India; bishtnsifs@yahoo.com
[4] Chair of Silviculture, University of Freiburg, Freiburg 79085, Germany
[5] Directorate of Extension, Indian Council of Forestry Research and Education, Dehra Dun 248001, India
* Correspondence: somidh.saha@waldbau.uni-freiburg.de or somidhs@gmail.com; Tel.: +49-761/203-8627; Fax: +49-761/203-3781

Abstract: The Himalaya is well known for high diversity and ethnobotanical uses of medicinal plants. However, not all areas of the Himalayas are well studied. In particular, studies on ethnobotanical uses of plants from the Eastern Himalayas are rare and lacking for many tribes. Past studies primarily focused on listing plants name and their traditional medicinal uses. However, studies on traditional ethnopharmacological practices on medicine preparation had not yet been reported in published literature from the Eastern Himalaya. In this study, we are reporting the first time ethnopharmacological used 24 medicines, their procedures of preparation and listed 53 plant species used for those medicines for Monpa tribe. Such documentations had not yet been done for other tribes in India. Our research demonstrates the urgent need to documents traditional medicine preparation procedures from the local healers before rapid cultural modernization forgets them in transforming country like India. This study should motivate national and international researchers to do more works on ethnopharmacology and bioprospecting.

Keywords: medicinal plants; traditional knowledge; Himalayas; mountain plants; ethnobotany

1. Introduction

The Himalaya is rich with a high diversity of medicinal plant species [1]. The culture of traditional healing of diseases using those plants is still prevalent among indigenous mountain communities in the Himalaya. Arunachal Pradesh, a state of the Republic Of India, is situated in the Eastern Himalayas. The entire state is a biodiversity hotspot with 5000 endemic flowering plant species as well as very high faunal diversity [1, 2]. Also, this state is the home to 28 major tribes and 110 sub-tribes and considered to be one of the most splendid variegated and multilingual tribal areas of the world [3]. The traditional wisdom of healing among mountain tribal communities is orally transferred from one generation to next generation through traditional healers, spiritual gurus, and elderly or sometimes ordinary people. This traditional wisdom, if not properly documented, can be lost by rapid modernization and reformation among mountain communities in Arunachal Pradesh where traditional customary practices were often treated as a symbol of backwardness and unscientific particularly among educated and young people. However, plant-based traditional wisdom has become a recognized tool in the search for new sources of drugs and pharmaceuticals in

modern medicine [4]. The field based ethnobotanical and ethnopharmacological survey can bring out many different clues for the development of drugs to treat human diseases [5].

Traditional uses of medicinal plants among Monpa tribe of Arunachal Pradesh were documented in past studies [2, 6]. Those studies commonly documented vernacular names of some plants, the traditional use of plants in the healing of different ailments, and sometimes described botanical and chemical properties of those plants. However, research on ethnopharmacology on how traditional healers of Monpa tribe in the Eastern Himalayas prepare drugs using different ratios of multiple species and their parts had not yet been done. This study aims to document traditional wisdom of drug making among Monpa people in Zemithang region of Arunachal Pradesh state, India.

2. Results

Our study was a notable departure from the previous studies from the area that mostly documented and described the use of plant parts in individual plant species. We recorded 53 plant species used as medicinal plants. We documented and described 24 ethnomedicines prepared for healing purposes from these 53 plant species (Table 1). These traditional medicines were most commonly used to heal a wide range of diseases such as arthritis, rheumatic pain, malaria, cough and cold, dysentery, etc. However, we recorded a description of medicines for more complicated diseases such as epilepsy (*Pambrey*), herpes (*Bukbukpa-khaksa -chandongbra*) and oedema (*Darshek sheng nye putpoo*) rarely found in past studies. Please see Table 1 for a detailed description of ethnomedicines. Table 2 provides the list of plant species used in ethnomedicine.

	Name of Ethnomedicine (in Monpa tribal language of Zemithang dialect)	Type of medicine	Name of medicinal plants used for ethnomedicine	Proportion of used plant parts	Mode of preparation	Medicinal use
1	Arkadamasisi	paste	*Crawfurdia speciosa* Wall.	1/4 bray of dried root + 1/8 bray of dried flower	dried roots and flower crushed together to prepare powder and then mixed with water to prepare paste	paste is appli externally for heali wounds
2	Baribama	decoction	*Aristolochia griffithii* Hook.f.	1/8 bray raw washed roots	roots are boiled with water to prepare a decoction	decoction is taken blood purifier a purgative
3	Blenga	pills	*Hedychium spicatum* Buch.-Ham.	1 bray washed raw roots	raw roots are crushed and small round pills are prepared and sun dried	pills are taken orally f treatment of dysentery
4	Bomdeng	paste	*Cirsium falconeri* Hook. f. , *Cirsium verutum* D.Don and *Onopordum acanthium*	1/2 bray washed raw root of *C.falconeri* + 1/2 bray of washed raw root of *C.verutum*+ 3/4 bray of washed raw root of *O.acanthium*	raw roots are mixed together and crushed to prepare paste	paste is appli externally to cu arthritis
5	Bragen	syrup	*Bergenia stracheyi* Hook.f. & Thorns.	1 bray washed fresh leaves	clear fresh leaves are crushed to prepare paste and mixed with 1/4 bray local millets wine to prepare syrup	syrup is taken for heali rheumatic pains

6	Bukbukpa-khaksa -chandongbra	paste	*Campanula latifolia* Linn.,*Codonopsis clematidea* Schrenk. and *Codonopsis viridis* Wall.	1/2 bray washed fresh leaves and 1/4 bray fresh flowers of each species + 1/4 bray conch powder + 1/4 bray water	leaves and flowers are crushed together and mixed with conch powder and water to prepare paste	paste is appli externally to cure herpe
7	Chandoo-konghlin-bhor	powder	*Aconitum ferox* Wall.ex Ser. , *Aconitum heterophyllum* Wall.ex Royle , *Aconitum hookeri* Stapf. , *Geranium polyanthes* Edgeworth & J. D. Hooker , *Geranium wallichianum* D.Don and *Picrorhiza kurrooa* Royle ex Benth.	1 small dried root from each plants of *A.ferox*, *A.heterophyllum* and *A.hookeri* (total 5 gram mixture of 3 plants) + 3 bray dried root of *G.polyanthes* and *G.wallichianum* + 1 bray dried root *P. kurrooa*	all are mixed together and crushed to prepare a powder	powder is taken orally overcome poisoni effects
8	Chhalachhusar	syrup	*Meconopsis grandis* Prain and *Meconopsis paniculata* D. Don	1/2 bray of dry leaves from each plant + 1/2 bray of dy flowers from each plant	dried leaves and flowers are mixed together and crushed to prepare powder, small amount of powder (5 gram) is mixed with 1 bray water to prepare a syrup	syrup is taken to cu sexually transmitt diseases
9	Chhurchu doho keusheng	pills	*Rheum australe* D. Don , *Rheum nobile* Hook.f. & Thoms. and *Bistorta affinis* D. Don	1/2 bray of fresh roots from each species + 1/4 bray of dried flowers from each species	fresh roots and dried flowers are crushed together to make a paste, then small round pills are prepared and sun dried	pills are taken orally overcome poisoni effects

10	Comrep	syrup	*Rubus ellipticus* Smith and *Rubus paniculatus* Smith	1/2 bray of fresh ripe fruits from each plant	roots are mixed together and crushed to prepare a thick syrup	syrup is used f treatment of cold a cough
11	Darshek sheng nye putpoo	decoction	*Pieris formosa* (Wallich) D. Don; *Vaccinium nummularia* Hook.f.&Thoms.	1/4 bray fruits of *P.formosa* + 1/4 bray fruits of *V.numularia* + 1/2 bray fresh roots of *P.formosa* + 1/2 bray fresh roots of *V.numularia*	mixture of all fresh fruits and roots along with water is boiled to prepare a decoction	decoction is taken to cu oedema
12	Dhamrep	paste	*Fragaria nubicola* Lindl. , *Geum elatum* Wall. and *Potentilla peduncularis* D. Don.	1/2 bray *F.nubicola* fresh fruits + 1/8 bray dried roots of *G.elatum* + 1/4 bray leaves of P.peduncularis	fresh fruits, leaves and dried roots are crushed together to prepare a paste	paste is taken orally cure cold, cough a fever
13	Gin sheng	powder	*Panax pseudo ginseng*	1/4 bray of dried rhizomes	dried rhizomes are crushed to prepare powder and keep it, taken with water	used for heali depression and fatigue
14	Karpo Chiito	paste	*Iris clarkei Baker*	1/4 bray of dried flower, leaves, stem and root	dried flowers, leaves, stem parts and roots are crushed together to prepare powder and mixed with local millets wine to prepare paste	paste is used externa to cure of muscle pain
15	Lowa bur bur	pills	*Lomatogonium carinthiacum*	1/4 bray of dried roots	dried roots are crushed and small round pills are prepared and sun dried	pills are taken orally cure cold, cough a fever

16	Maraptang	pills	*Houttuynia cordata* Thunb.	1/4 bray of dried roots	dried roots are crushed and small round pills are prepared and sun dried	pills are taken orally f treatment of piles
17	Nyasheng jormu	paste and pills	*Viscum articulatum* Burm. f.	1/4 bray of fresh roots + 1/4 bray of fresh leaves + 1/4 bray of fresh stems	fresh roots, leaves and parts of stem crushed together to prepare paste, sometimes paste is used to prepare small round pills and sun dried	paste is used to jo broken bones, curi pain from swelling nerves and heali wounds, pills are us for treatment infertility among wom
18	Pambrey	mixture	*Anaphalis monocephala* DC. , *Anaphalis triplinervis* Sims. , *Gnaphalium hypoleucum* DC. , *Leontopodium himalayanam* DC. , *Leontopodium jacotianum* Beauv. , *Tanacetum tibeticum* Hook f. and *Tanacetum gracile* Hook. F. & Thoms.	1/2 bray flowers from each plants	flowers are kept in dark place for 2 days after plucking and then mixed together	used to cure epilepsy, t whole mixture is usual burned on the head patient after cutting hairs in a such way th will not make any fi wounds for consecuti 15-20 days at t different position of he
19	Pangen	pills	*Gentiana depressa* D. Don , *Gentiana ornata* Wallich ex G. Don , *Gentiana phyllocalyx* C. B. Clarke and *Gentiana tubiflora* Wallich ex G. Don.	1/4 bray of dried roots from each plants	dried roots are crushed and then mixed with 1/4 bray of local millet wine and 1/2 bray of water and small round pills are prepared and sun dried	pills are used to cu cough, cold a headache

20	Rah-nya	decoction	*Smilacina purpurea S.oleracea* and *Polygonatum multiflorum All.*	1/4 bray of fresh roots from each plants	roots are boiled with water to prepare a decoction	is used for treatment malaria
21	Rambhoo tsarphakur	paste	*Morina longifolia* Wall. , *Pterocephalus hookeri* (C. B. Clarke) Hock.	1/4 bray dried flowers, 1/2 bray of fresh roots, 1/4 bray of fresh fruits of *M.longifolia* + 1/8 bray of dried flower, 1/2 bray of fresh roots, 1/2 bray of fresh fruits of *P.hookeri*	flowers, roots and fruits of both plants are mixed together and crushed to prepare paste	paste is applied f healing chest pain
22	Trahm-Sheng	paste	*Corydalis cashmeriana* Royle.	1/4 bray of fresh leaves + 1/4 bray of fresh flower	fresh leaves and flowers are crushed to prepare paste	paste is applied f healing wounds
23	Wang La	powder	*Swertia chirayita* (Roxb. ex Flem.)Karst. and *Swertia hookeri*	1/2 bray of dried whole plants	dried whole plants are crushed to prepare powder and keep it, taken with water	powder is used to cu malaria, as purgati and laxative
24	Whan	pills	*Lilium nepalense* D. Don	1/2 bray of dried roots	dried roots are crushed and mixed with water to prepare small round pills and sun dried	pills are used for heali gastritis and stomachic

Table1: List of 24 ethnomedicines used by Zeminthang Monpa people and associated medicinal plants documented in this study (1 bray = 900 gram).

Sl No.	Botanical Name	Family	Type
1	*Aconitum feroxWall.ex* Ser.	*Ranunculaceae*	herb
2	*Aconitum heterophyllum* Wall.ex Royle	*Ranunculaceae*	herb
3	*Aconitum hookeri* Stapf.	*Ranunculaceae*	herb
4	*Anaphalis monocephala* DC.	*Compositae*	herb
5	*Anaphalis triplinervis* Sims.	*Compositae*	herb
6	*Aristolochia griffithii* Hook.f.	*Aristolochiaceae*	vine
7	*Bergenia stracheyi* Hook.f. & Thorns.	*Saxifragaceae*	herb
8	*Bistorta affinis* D. Don	*Polygonaceae*	herb
9	*Campanula latifolia* Linn.	*Campanulaceae*	herb
10	*Cirsium falconeri*Hook. f.	*Asteraceae*	herb
11	*Cirsium verutum* D.Don	*Asteraceae*	herb
12	*Codonopsis clematidea* Schrenk.	*Campanulaceae*	herb
13	*Codonopsis viridis* Wall.	*Campanulaceae*	herb
14	*Corydalis cashmeriana* Royle.	*Papaveraceae*	herb
15	*Crawfurdia speciosa* Wall.	*Gentianaceae*	herb
16	*Fragaria nubicola* Lindl.	*Rosaceae*	herb
17	*Gentiana depressa* D. Don	*Gentianaceae*	herb
18	*Gentiana ornata* Wallich ex G. Don	*Gentianaceae*	herb
19	*Gentiana phyllocalyx* C. B. Clarke	*Gentianaceae*	herb
20	*Gentiana tubiflora* Wallich ex G. Don.	*Gentianaceae*	herb
21	*Geranium polyanthes* Edgeworth & J. D. Hooker	*Geraniaceae*	herb
22	*Geranium wallichianum*D.Don	*Geraniaceae*	herb
23	*Geum elatum* Wall.	*Rosaceae*	herb
24	*Gnaphalium hypoleucum* DC.	*Asteraceae*	herb
25	*Hedychium spicatum* Buch.-Ham.	*Zingiberaceae*	herb
26	*Houttuynia cordata* Thunb.	*Saururaceae*	herb
27	*Iris clarkei* Baker	*Iridaceae*	herb
28	*Leontopodium himalayanam* DC.	*Asteraceae*	herb
29	*Leontopodium jacotianum* Beauv.	*Asteraceae*	herb
30	*Lilium nepalense* D. Don	*Liliaceae*	herb
31	*Lomatogonium carithiacum* (Wulfen)Rchb.	*Gentianaceae*	herb
32	*Meconopsis grandis* Prain	*Papaveraceae*	herb
33	*Meconopsis paniculata* D.Don	*Papaveraceae*	herb

34	*Morina longifolia* Wall.	*Dipsacaceae*	herb
35	*Onopordum acanthium*L.	*Asteraceae*	herb
36	*Panax pseudoginseng*Wall.	*Araliaceae*	herb
37	*Picrorhiza kurrooa* Royle ex Benth.	*Scrophulariaceae*	herb
38	*Pieris formosa* (Wallich) D. Don	*Ericaceae*	shrubs
39	*Polygonatum multiflorum* All.	*Convallariaceae*	herb
40	*Potentilla peduncularis* D. Don.	*Rosaceae*	herb
41	*Pterocephalus hookeri* (C. B. Clarke) Hock.	*Dipsacaceae*	herb
42	*Rheum australe* D. Don	*Polygonaceae*	herb
43	*Rheum nobile* Hook.f. & Thoms.	*Polygonaceae*	herb
44	*Rubus ellipticus* Smith	*Rosaceae*	shrubs
45	*Rubus paniculatus* Smith	*Rosaceae*	shrubs
46	*Swertia chirayita* (Roxb. ex Flem.)Karst.	*Gentianaceae*	herb
47	*Smilacina oleracea* (Baker) Hook.f.	*Liliaceae*	herb
48	*Smilacina purpurea* (Wall.) H.Hara	*Liliaceae*	herb
49	*Swertia hookeri* C.B. Clarke	*Gentianaceae*	herb
50	*Tanacetum gracile* Hook. F. & Thoms.	*Asteraceae*	herb
51	*Tanacetum tibeticum* Hook f.	*Asteraceae*	herb
52	*Vaccinium nummularia* Hook.f.&Thoms.	*Ericaceae*	shrubs
53	*Viscum articulatum* Burm. f.	*Viscaceae*	shrubs

Table 2: List of recorded plants used in Ethnomedicine

3. Materials and Methods

Study area

The study area is located in the extreme north of the north-western Arunachal Pradesh. The areas of investigations are situated at the Lumla- Zemithang administrative circle of the Tawang district of the Arunachal Pradesh. This region is situated along the bank of the river Namshyang Chu that is flowing through this area. The name, exact locations, and altitude of three villages where the study was taken place are as follows: 1) village Kublaitang N27º37'070", E91º41'618," elevation 2224 meter; 2) village Shakti N27º36'736," E91º42'970," elevation 2020 meter; 3) village Lumpho N27°43′140″, E091°43′069″, elevation 2550 meters. The research areas come under the middle Himalayan range of the Eastern Himalayas. The soil on hills is moderately deep and moist, fertile loamy layer stained with humus. At places, shallow soils are not uncommon with an underlaying boulder, sand, and rocks. The subsoil at lower elevation consists of mostly boulders and pebbles superimposed by a layer of a sandy loam of various depths and over it layers of humus. Relative humidity of this area varies from 30% to 80%. Southern aspects at low altitude areas are most humid than any other place. In this area temperature varies from -10 degree Celsius to +15 degree Celsius. The area receives 1500 -1800 mm rainfall in every year. The dry months are December, January & February. The pre-monsoon rainfall starts from the end of the March. Highest rainfall is observed in June, July, and August [7]. The forest type of the research area is the Northeastern Himalayan subalpine mixed conifer forests. The top canopy of the forest consists of *Abies densa, Juniperus wallichiana, Illicium griffithi* and *Cupressus torulosa.* The second storey mainly consists of *Rhododendron* spp., *Betula utilis, Pyrus aucuparia* and *Salix walliechiana.* The trees of ground storey are dominated by *Juniperus recurva* *Cassiope fastigiata* and *Rhododenetron lepidotum* [8]

Field surveys

Field surveys were done at the three sample villages of the Zemithang region of Tawang district. The research was carried out in three stages. In the first stage, ethnobotanical data has been collected from the research area. At the second stage, ethnopharmacological information was collected from the same research area. The herbarium of the collected plant specimens was made and verified at the third stage of the research at the Forest Research Institute of Dehradun, India. The participatory transect walk, interview and discussions with traditional healers were used for ethnobotanical data collection. The total number of participatory transect established were 3 for every village that is total 9 for all 3 villages. The length of each transect was 2 km from the centre of the village to 3 different outward directions depending on aspects of the village. We have used three different groups for transect walk. They were common village people including men and women, hunters and traditional healers. Two walks with every group with different people had conducted. So the total number of transect walk per village was 6 and 18 for total three villages. This type of data collection design was followed for the robustness of ethnobotanical information. Apart from this technique for collecting plant specimen with ethnobotanical values, we used a structured questionnaire for an interview and group discussions of traditional healers and tribal people for ethnobotanical uses of collected plants. The people who participated in transect walks was not selected for questionnaire survey to avoid repetition and get general idea among larger population group. The participatory transect walks were mostly carried out in spring and summer when the flush of herbaceous plants grow in the forest, pasturelands, meadows after melting of winter snow.

At the second stage of the research, ethnopharmacological information was collected from the high ranked Monks and traditional healers who live in Gompas and use to prepare medicine from plants for the healing of the tribal people. The basic information that was collected from these Monks and traditional healers are 1) plants needed to make medicine, 2) use of plant parts, 3) different ratio of plant use, 3) technique of preparation, 4) doses and prescription to the patients and 5) medicinal uses. The third stage of the research was carried out at the Resource Survey and Management Division of the Forest Research Institute, Dehradun, India. The voucher specimens collected during fieldwork were used for the preparation of the herbarium. Taxonomical classification had done with the help of the Botany Division of the Forest Research Institute and identified plant specimens were confirmed with the herbaria of the same division.

5. Conclusions

We documented first time the vernacular names and ethnopharmacological preparations of Ethnomedicines among Monpa tribes. Past studies on ethnobotany in Arunachal Pradesh, Eastern Himalayas, listed species wise use of medicinal plants. However, in reality, traditional healers use multiple species and plant parts for drug preparation. We have tried to report that and not only merely report the use of a specific plant. It is the main novelty of this study. Our study illustrates the complexity of medicinal drug preparations and traditional knowledge that passed through generation after generation. These ethnopharmacological documentations should motivate national and international researchers to carry further researches on pharmacology and bioprospecting. Under ongoing warming of Himalayas, our study also highlights the needs to document the use of local flora and to develop sustainable strategies to conserve them before they are lost and knowledge are forgotten.

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